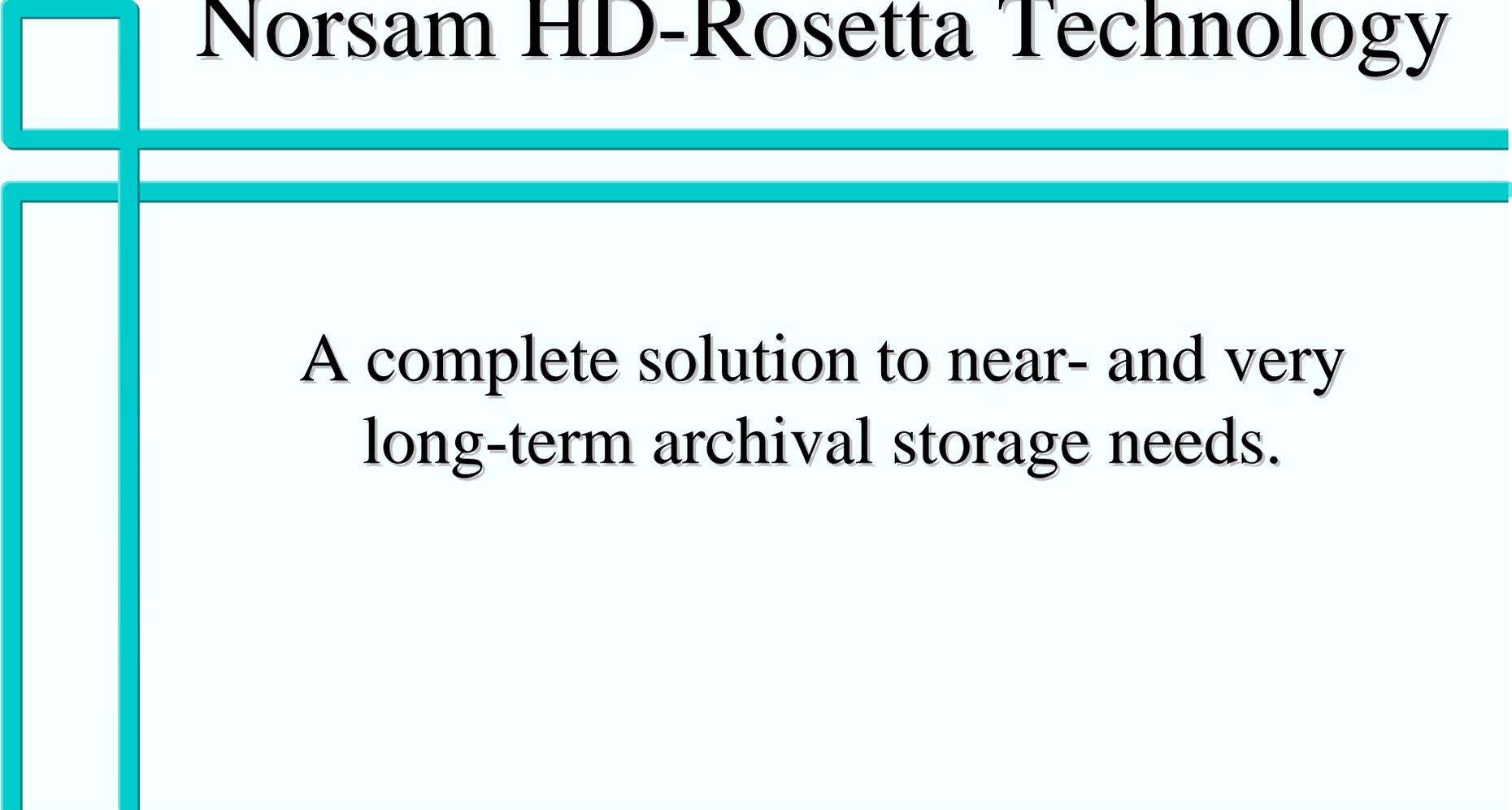


Norsam Technologies, Inc.

Ultra-High Density
Analog and Digital Data Storage

Digital and Analog Technology





Norsam HD-Rosetta Technology

A complete solution to near- and very long-term archival storage needs.

Archival Needs and Problems

- Archival Worthiness
- Storage Space
- Accessibility
- Format consistency

Analog Market

- AIIM Estimates \$7.5 Billion Microfilm Market in 1994
- Freeman Associates Estimates \$35 Billion Market for Norsam Technology
- Government, Banks, Historical Organizations: On-, Near- and Off-Line

Current Solutions, Limitations

- Paper
- Microfilm, Microfiche
- Digitization

Limitations to Current Methods

■ Comparative Weights and Volumes of Archived Data

NORSAM Weight	NORSAM Volume	Fiche weight	Fiche volume	Paper weight	Paper volume
348 lb.	0.63 ft ³	93 lbs.	1 ft ³	10,200 lb.	206 ft ³
196 lb.	0.35 ft ³	(Invariant)	(Invariant)	(Invariant)	(Invariant)
64 lb.	0.12 ft ³	"	"	"	"
3.1 lb.	.005 ft ³	"	"	"	"
1.8 lb.	.003 ft ³	"	"	"	"
.79 lb.	.001 ft ³	"	"	"	"
3.2 oz.	0.6 in ³	"	"	"	"
0.8 oz.	0.2 in ³	"	"	"	"

■ Environmental Controls. Media Degradation.

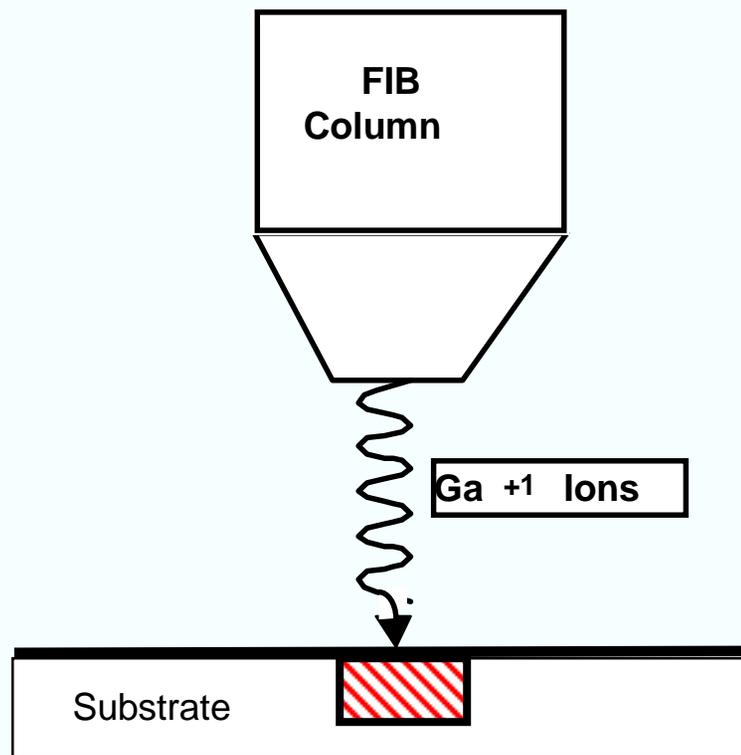
Microfilm

- Microfilm Storage Costs: \$3,000/Year per Million Images
- Lifetime Limits: Microfilm = 100 Years
CDs = 50 Years Paper = 100 Years

Focused Ion Beam Technology for High Density Archival Storage

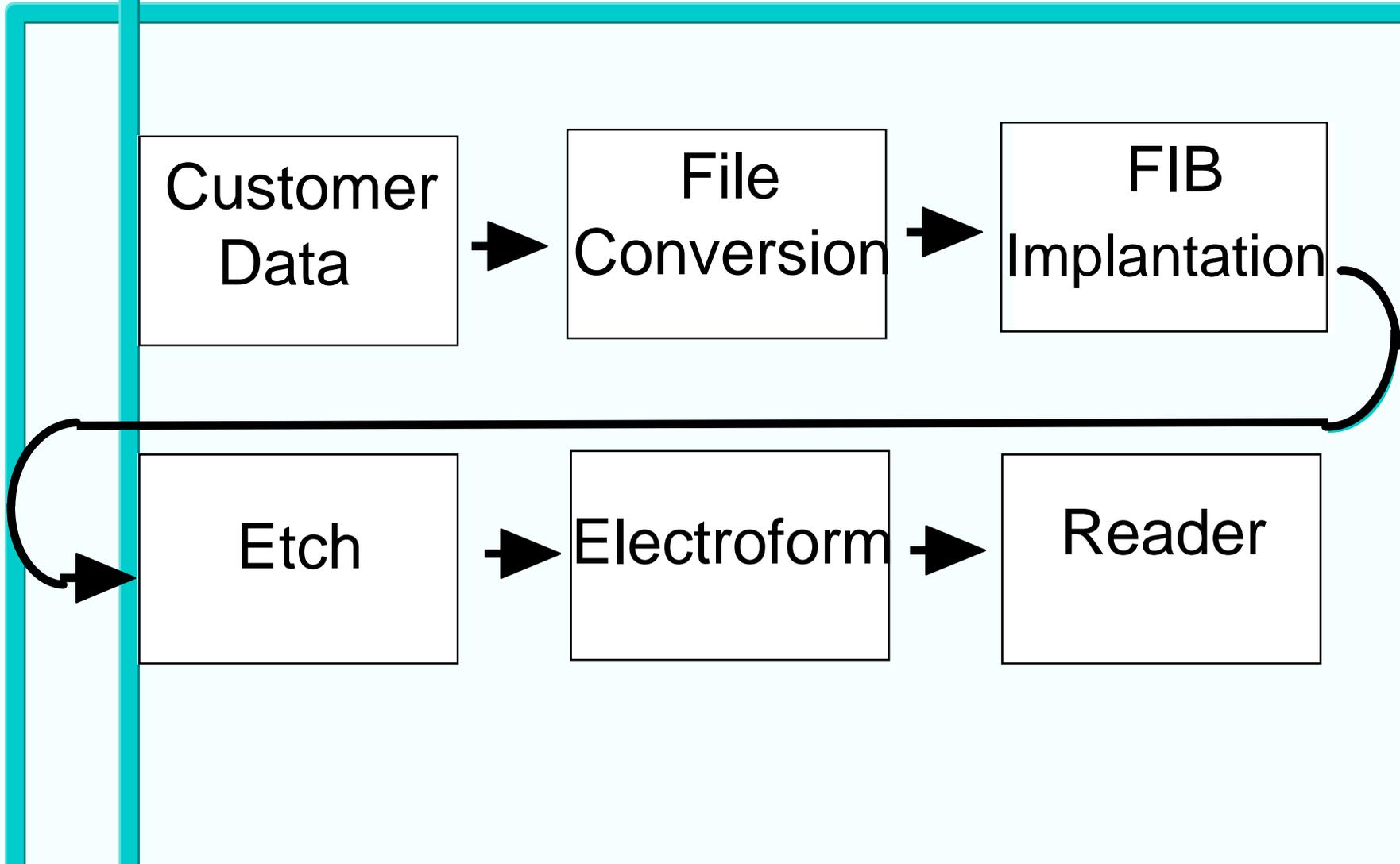
- Breakthrough technology
- Addresses all archival needs

Focused Ion Beam Technology

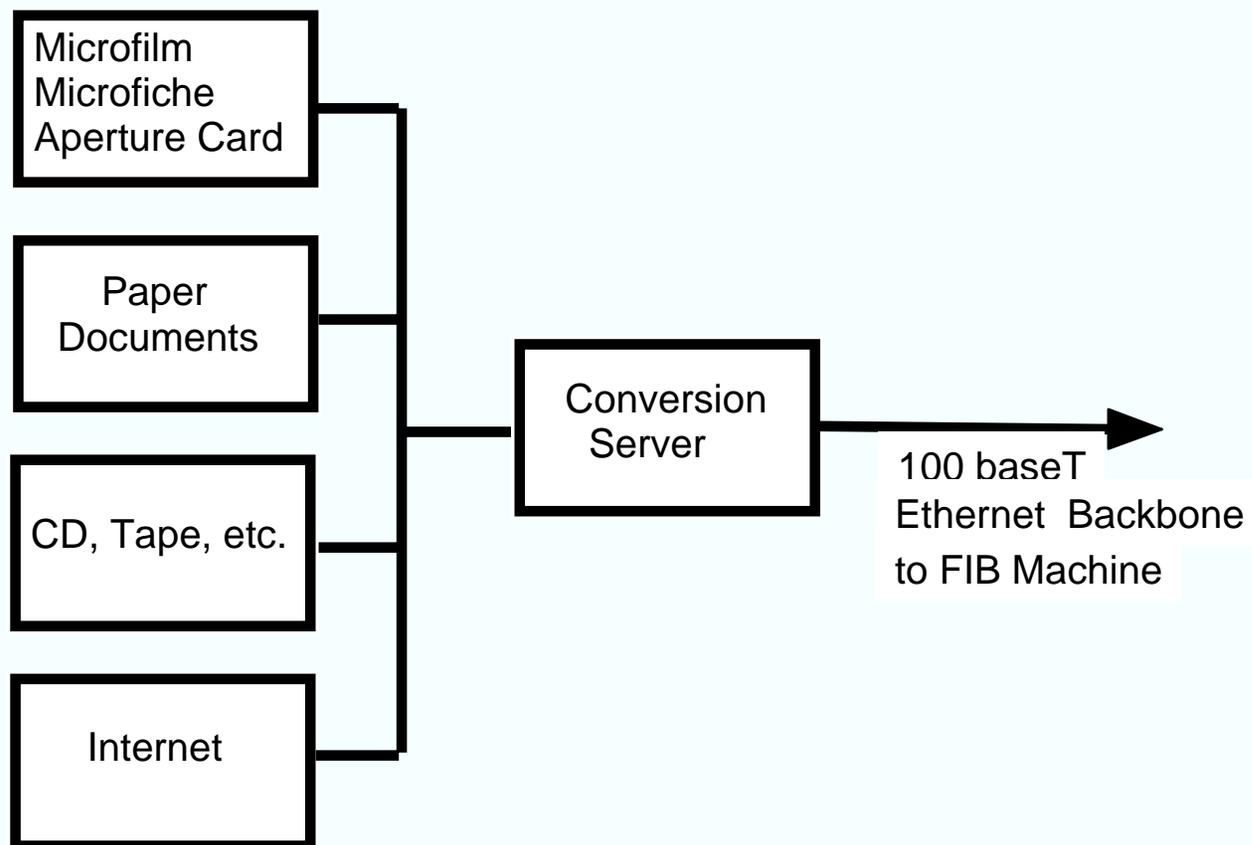


- Probe size 10 nm
- Precise positioning
- Complete Automation

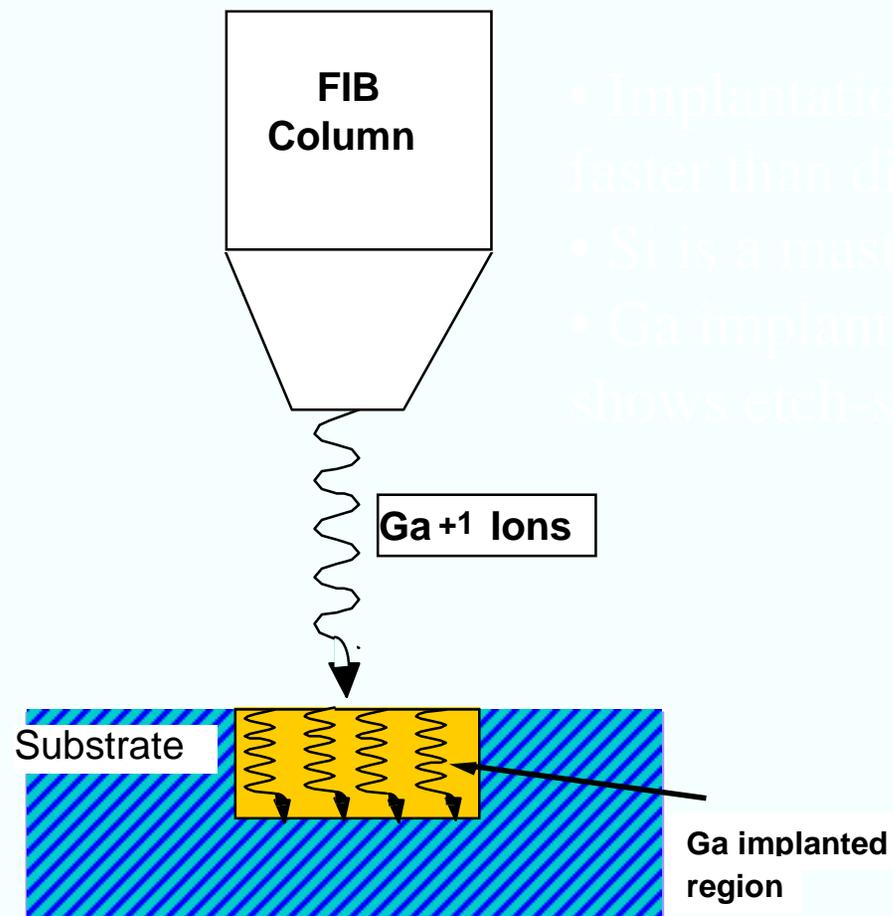
Outline of Write Process



Write Process: Data Conversion

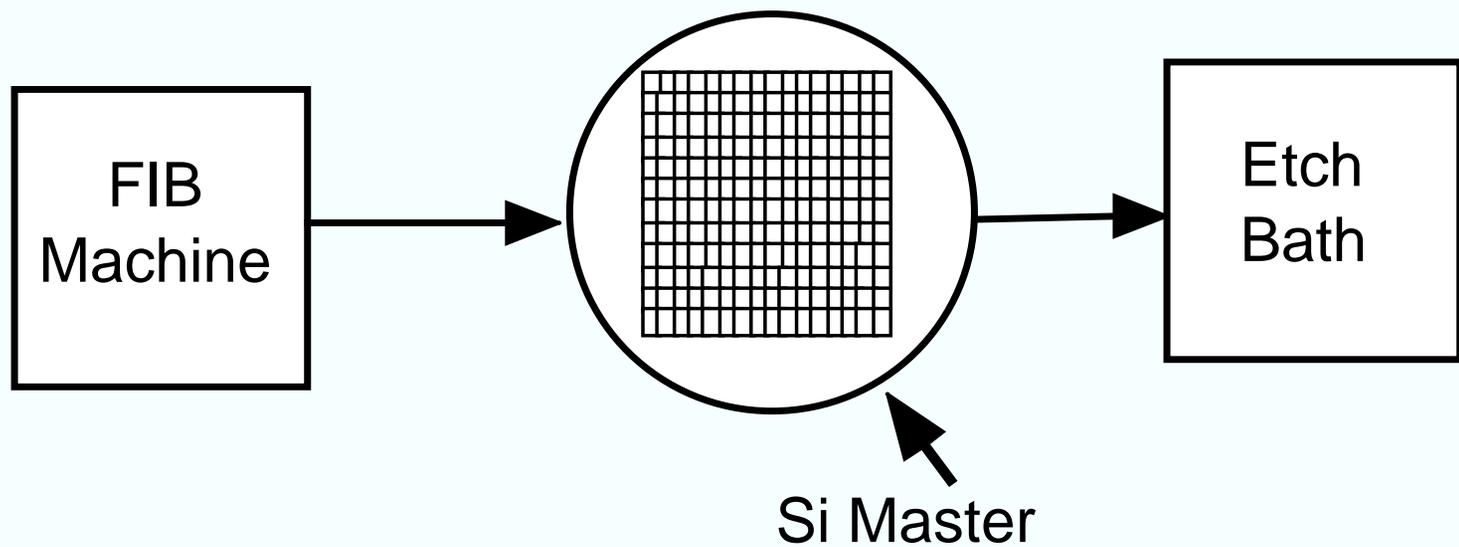


Implantation



- Implantation is > 1000 faster than direct milling
- Si is a master substrate
- Ga implanted region shows etch-stop behavior

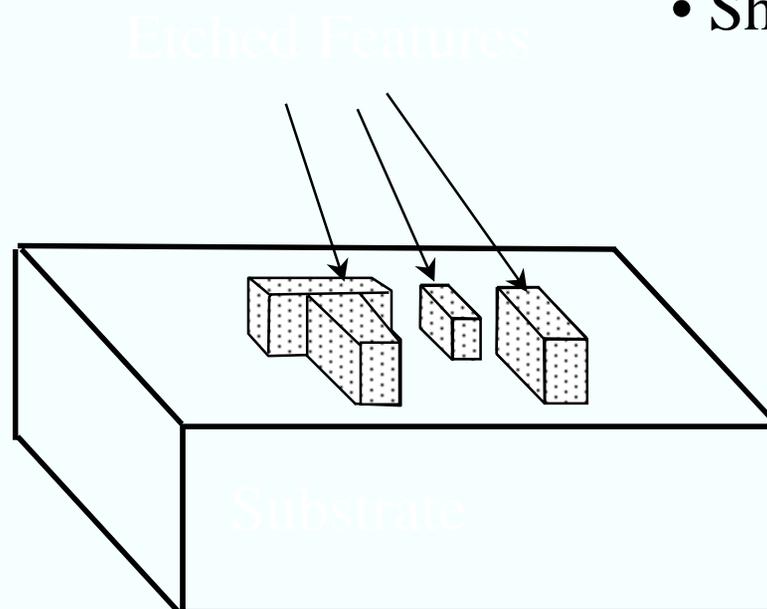
Etching



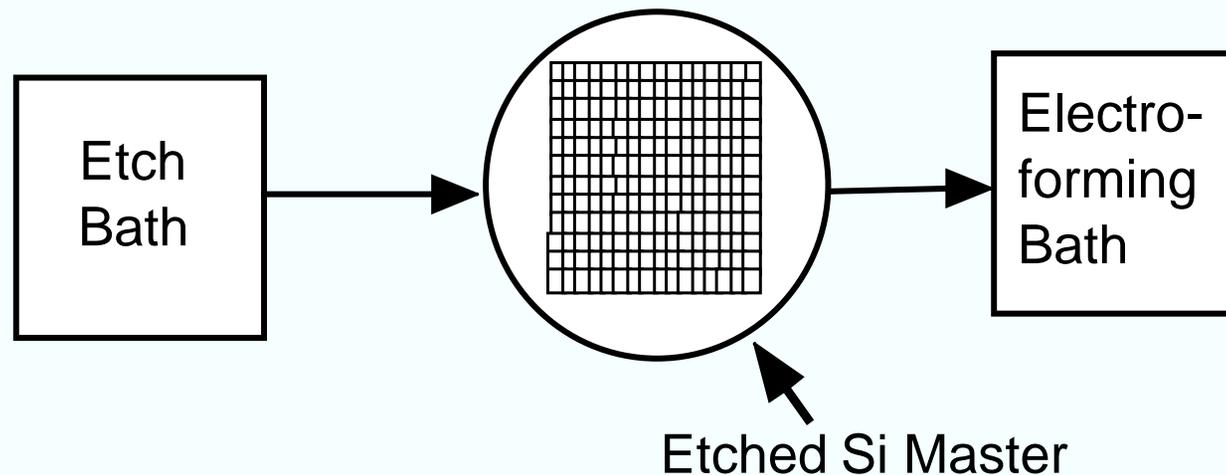
NOTE: MAYBE SHOW A REAL Si MASTER NOW

Etching (cont)

- Implanted regions etch slower
- Etch rate is function of dose
- Short etch times, batch process

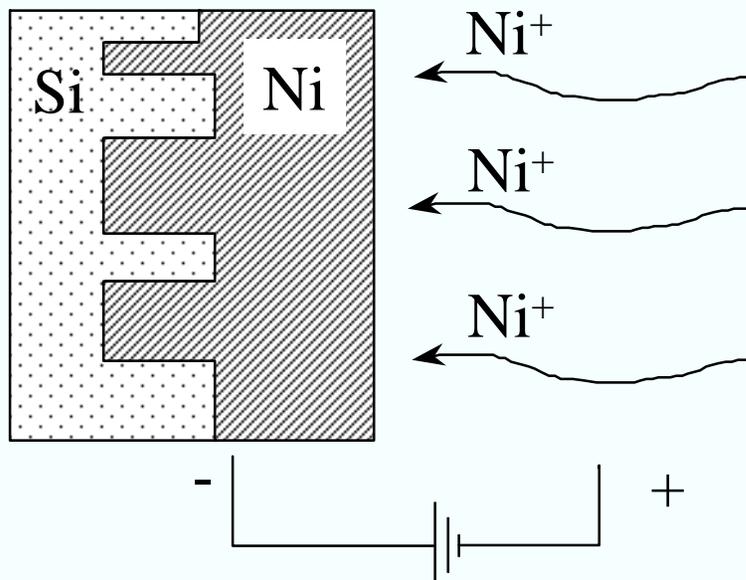


Electroforming into Archival Substrate



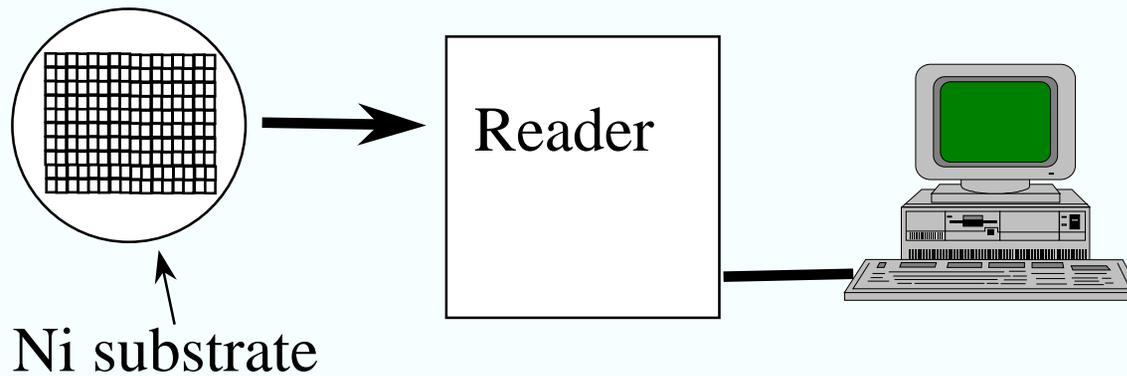
- Si is not archival due to inherent brittleness
- Electroforming allows extremely accurate transfer of data into other, archival media
- CD/DVD manufacturing depends upon this process

Electroforming (cont.)



- Nickel is tough, strong, and corrosion resistant
- Electroforming is rapid, accurate, and low cost
- Archival substrate is $\approx 200 \mu\text{m}$ thick

Readback of Data



- PC Controlled
- Full Search and Index Capable

Capacities

Number of Pages per Wafer as a Function of Pixel Size

Pixel Size	Page Size*	2" WAFER	8" WAFER
0.2 micron	0.66 x 0.50 mm	5837	95615
0.1 micron	0.33 x 0.25 mm	23725	383943
50 nanometer	0.17 x 0.13mm	95640	1538770
25 nanometer	0.08 x .06 mm	384092	6160951

* 8 1/2 x 11 Page @ 300 dpi

Summary

- HD-ROM Rosetta Discs may be manufactured out of extremely durable materials, such as nickel. It survives most fires, is nonmagnetic, and will not be affected by electromagnetic pulses or radio frequencies.
- HD-ROM is currently capable of storing up to 700 times the capacity of current 4.75" CD.
- These capabilities establish HD-ROM as the densest and safest practical form of archival data storage in existence and provides unprecedented potential for large scale data users and archivists.

HD-ROM

- High Density Read Only Memory
- Electron Beam Writer
- Near Field Optical Reader

HD-ROM Specifications

- 50 nm pit size
- 165 GB per 120 mm disc.
- 15 msec access time
- Write rates 20 - 50 Mbytes per second
- Read rates 6 - 10 Mbytes per second

Electron Beam Writing

- Norsam will partner with ebeam company
- Beam blanker speed
- Photoresist sensitivity
- Stage design

SIAM Reader

- Scanning Interferometric Apertureless Microscopy
- Developed at IBM Yorktown
- Norsam has signed exclusive joint development and know-how agreement with IBM

SIAM Reader

- Microscope produces diffraction limited laser spot
- Tip-sample interactions produce scattered waves.
- Phase changes define feature
- 1 nm resolution
- 6 Mbytes ps initial read rate, 10 Mbytes per second read rate projected
- Flying Head design
- < \$1000
- Compact footprint

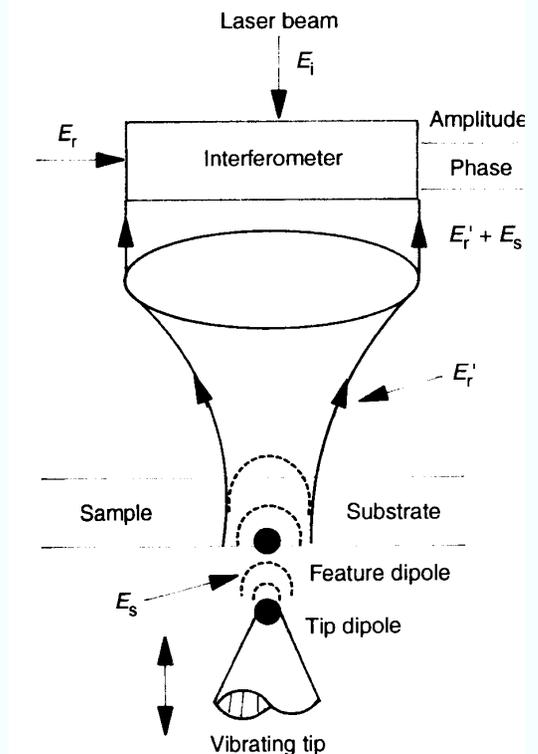


Fig. 1. Principle of the SIAM method.

1084

F. Zenhausern, Y. Martin,
H.K. Wickramasinghe,
Science, v. 269, 1083 (1995).

Summary

- HD-Rosetta is near production.
- Preliminary contracts with NLM and others.
- HD-ROM: 24 month development time projected
- Combined technologies has advantages for archivists and large databases.